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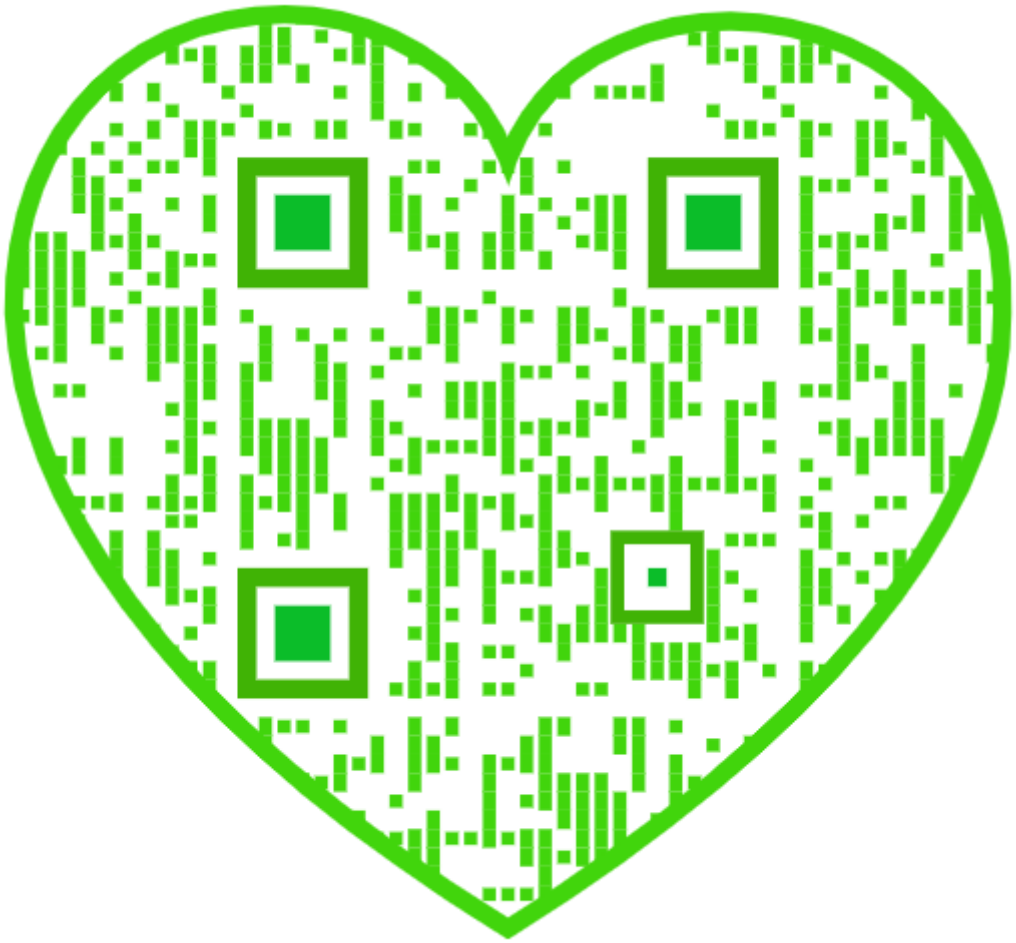

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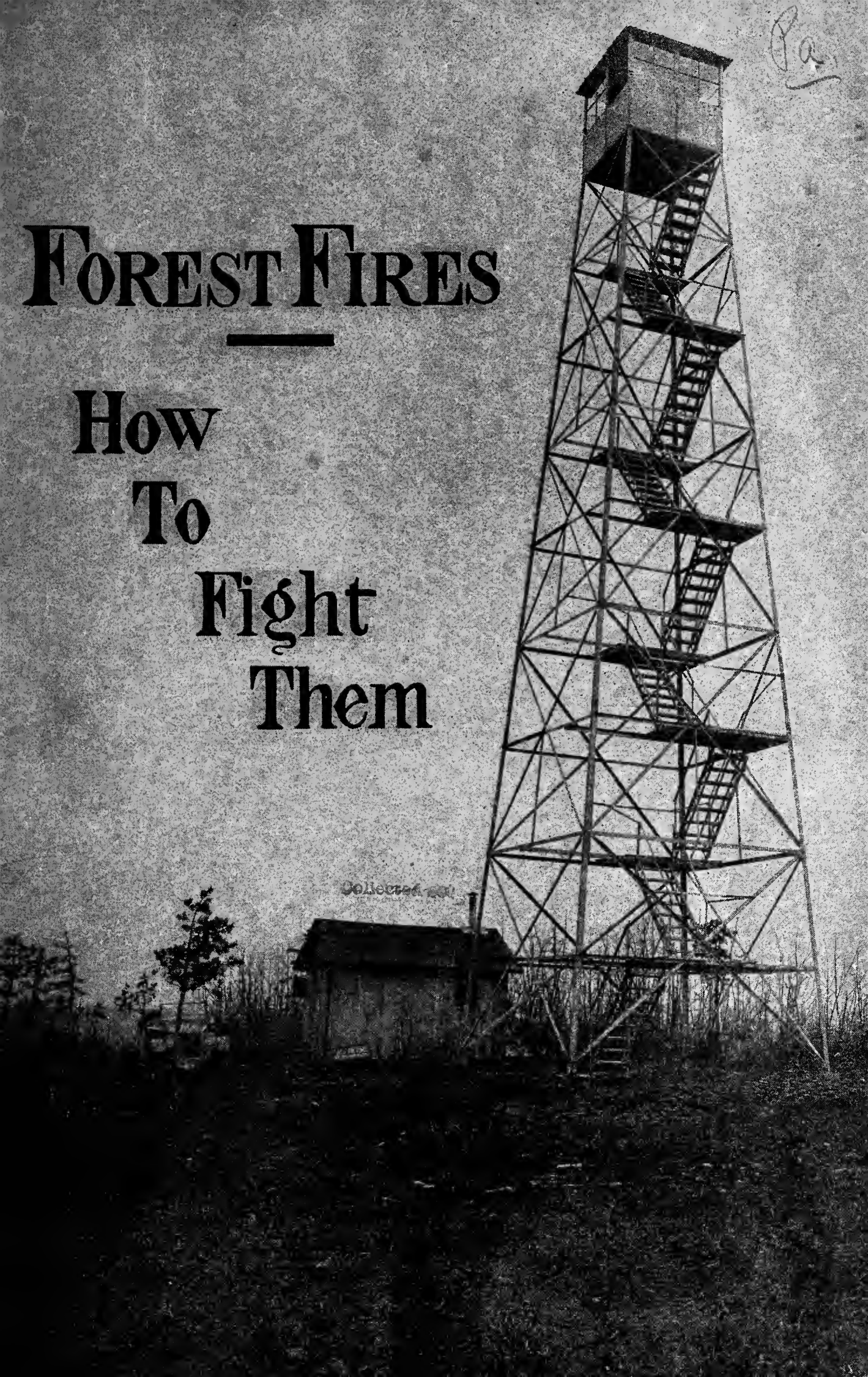
Book

FOREST FIRES

How To Fight Them



COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF FORESTRY

FOREST PROTECTION
FIRE PREVENTION AND EXTINCTION

BULLETIN 27

R. Y. STUART, COMMISSIONER

1922

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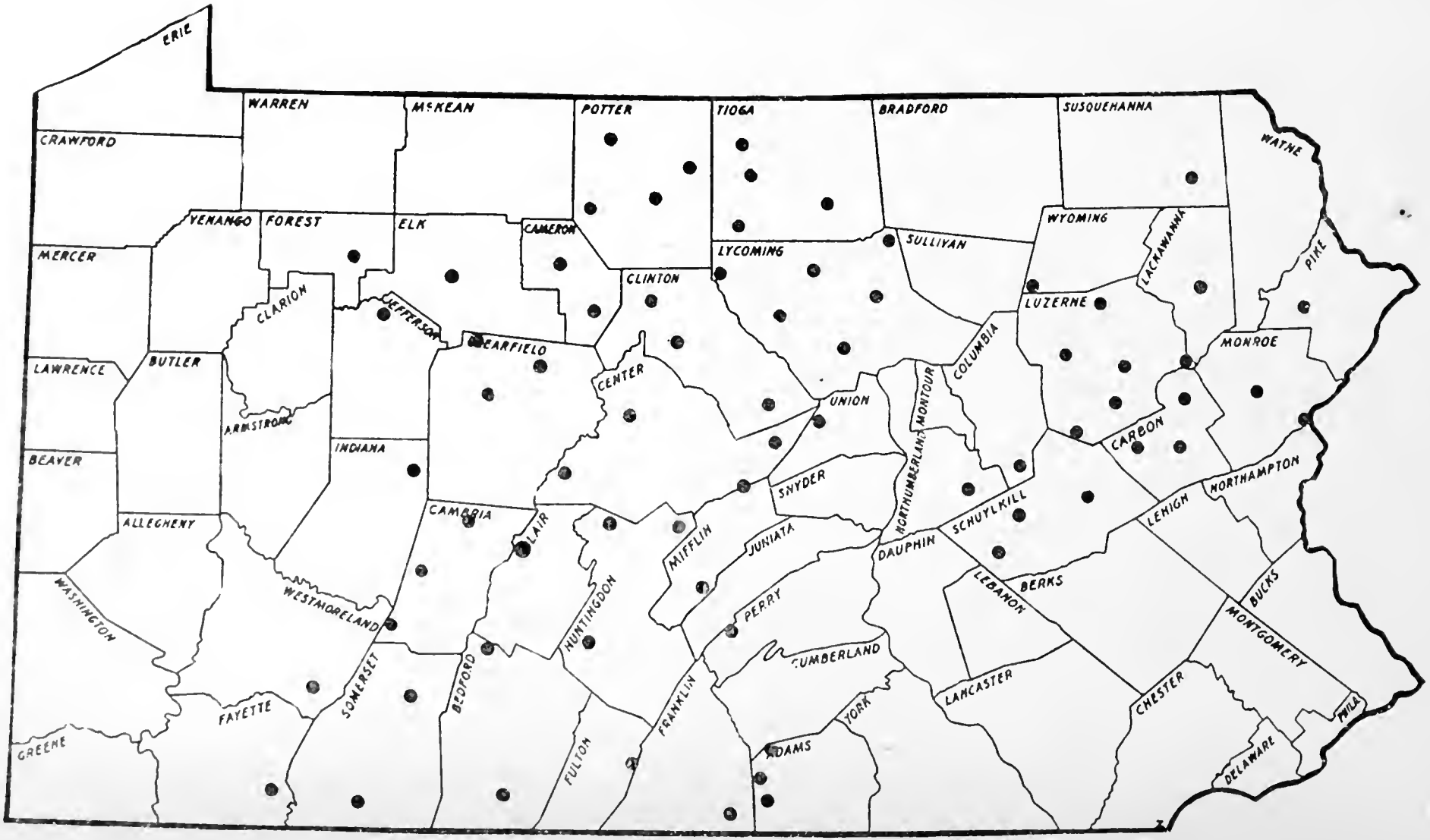
PREVENT FOREST FIRES — IT PAYS



FIRE OBSERVATION TOWER SYSTEM IN PENNSYLVANIA

FOREWORD

THE FOREST IS YOUR FRIEND.

THE WATER YOU DRINK COMES FROM IT.

NOTHING YOU USE OR WEAR COULD BE YOURS WITHOUT THE FOREST'S HELP.

THE STATE FORESTS ARE YOUR PLAY-GROUNDS. THEY ARE WIDE OPEN FOR YOU TO FISH, HUNT AND CAMP.

OUR FORESTS ARE ALMOST GONE.

THEY WILL GROW AGAIN IF FIRES ARE KEPT OUT.

THE FOREST FIRE IS YOUR ENEMY.

GIFFORD PINCHOT.

INTRODUCTION

This guide has been prepared for Pennsylvania Boys. Because many of them have given valuable assistance in forest protection, the Department of Forestry believes they are anxious to do effective work in forest fire extinction. This booklet is intended, therefore, to tell some of the interesting facts about forest fire, how it burns, how it may be prevented, and how it may be put out.

FORESTS NECESSARY IN PENNSYLVANIA.

Forest fires must be prevented because the future prosperity of Pennsylvania depends upon her supply of wood. We cannot get along without it—nothing we eat, nothing we wear can be supplied without wood. We cannot have this wood supply as long as fire endangers every acre of growing trees, and burns about 200,000 acres of forest land every year. We must provide for our future needs, therefore forest fires must be prevented.

HOW FOREST FIRES START.

Much might be written about how fires start and why they start. The kinds of fire may be grouped under two headings— (1) Non-preventable; (2) Preventable.

CLASSIFICATION OF FIRES:

1. Non-preventable.
   Instances: Lightning and spontaneous combustion.
2. Preventable.

(a) Incendiary—Fires set maliciously. (Back-firing in good faith does not fall within this class.)

Instances: Burning of another's woodland for one's own advantage.

(b) Railroads—Fires caused during the construction, operation, or maintenance of railroads, except those used in lumber operations. These fires are of two classes: From engines, or from the right-of-way.

(c) Lumbering—Fires caused by lumber operations.

(d) Burning Brush and Litter—Fires caused while clearing land except those mentioned above.

(e) Transients—Fires resulting from the carelessness of campers, picnickers, surveyors, laborers (except railroad and lumber operations), hunters, automobilists and other travellers or workers in the forest.

(f) Miscellaneous—Fires, the origin of which is known, but which cannot be classified properly under any of the heads mentioned above.

Instances: Tractors, fireworks, breaking of electric transmission lines, etc.

(g) Unknown—Fires, the origin of which cannot be fixed so as to include them under any other head.

NUMBER OF FOREST FIRES BY CAUSES.

Year.	Railroads	Brush Burning	Incendiary	Transients	Lumbering	Lightning	Misc.	Unknown	Total
1915	274	105	120	136	28	19	37	382	1,101
1916	270	55	95	182	44	10	45	312	1,013
1917	756	179	127	200	45	3	52	731	2,087
1918	402	115	118	90	40	6	102	587	1,625
1919	250	77	76	118	28	3	20	378	950
1920	553	104	128	218	44	4	25	521	1,597
1921	979	129	96	121	13	10	119	917	2,384

This table of causes of forest fires in Pennsylvania shows:

1. That very few fires are caused by lightning.
2. That carelessness or neglect by someone causes more than ninety-nine per cent of the forest fires. No matter what the immediate or apparent cause may be, the real cause can be traced in most cases to carelessness or neglect.

   Sparks from railroad and other engines cause the greatest number of fires. The engines have not been properly equipped with spark arrestors and closed ash pans or have been carelessly operated; safety strips have not been provided or track patrolmen have not put out the sparks.

   Smokers are probably responsible for the next largest class of fires. They are careless with matches and burning tobacco.

   Campers are careless or negligent with their camp fires, either in building them or in leaving without putting them out.

   Those who burn brush do not take precautions to keep their fires constantly under control.
3. That some fires are set purposely.

PREVENT FOREST FIRES.

Pennsylvania will continue to have forest fires, until every person knows the value of forests and realizes the great damage caused by carelessness with fire. The first thing necessary, therefore, in order to save the forests is to have every one learn how forests benefit them and how impossible it is to live without forests and forest products.

Persons who smoke while walking or riding through the forest should not drop fire upon the dry leaves or grass. They must take no chances with matches, cigars, cigarettes, or pipe.

Those who build fires in the forest should first clear a big space; should keep the fire small; should not build it against a log or hollow tree; and should be sure to put out every spark before leaving.

Persons should burn brush, while clearing fields, woods, or fence rows only when the woods are damp, and then only with sufficient help and under advice of a forest fire warden.

Those who operate wood or coal-burning engines in or near forests must insist upon equipment which will not permit sparks to escape.

Persons who persist in their carelessness or who purposely set fire to the forests should be punished. In order to do this local officials and neighbors should be interested so they will help prosecute the case.

REMOVE FOREST FIRE HAZARDS.

Some fires are started because of an unnecessary accumulation of inflammable material at places where the use of fire cannot be prevented. The size of forest fires may be greatly increased because of these accumulations. The removal of this material from roadsides, railroads, sawmills, and engines is important.

The Chief Forest Fire Warden of the Pennsylvania Department of Forestry has issued the following statement concerning hazards that must be removed:

"Under the provisions of the Act of June 3, 1915, it is my duty as Chief Forest Fire Warden to declare a public nuisance any property which, by reason of its condition or operation, is a special forest fire hazard, and, as such, endangers other property or human life. In Section 1004 the Act further provides that every person or corporation refusing to comply with an order of the Chief Forest Fire Warden for the abatement of a nuisance, under this act, shall be guilty of a misdemeanor, and upon conviction thereof shall be sentenced to pay a fine of not more than One Hundred Dollars, or undergo imprisonment not exceeding one month, or both, in the discretion of the court * * * and every day's continuance * * * shall be a separate and distinct offense.

"1. Engines of all kinds not provided with effective spark arresters, ash pans, or other equipment to prevent the spread of fire when such engines operate within 200 feet of woodland or of other inflammable property likely to spread fire to woodland.

"2. Inflammable debris within 100 feet of a steam railroad track. This includes uncleaned woodland which requires cleaning for the completion of a safety-strip along the railroad.

"3. Inflammable debris located within a radius of 150 feet from a sawmill or other engine operating within woodland or operating within 150 feet of woodland.

"4. Inflammable debris within 25 feet of the edge of the traveled part of a public highway, the clean road bed of an electric railway, or of any other frequented highway.

"5. Slash from lumbering operations without a protective strip of 100 feet adjoining woodland.

"As used above, debris means such material as slash, mowings, or other wastage, and accumulated forest litter.

"It should be understood that in unusual or extraordinary cases the Department is not restricted to action based upon the conditions cited above. Its duty is to invesigate independently, or upon report, all forest fire hazards and to base its action upon the conditions in each particular case.

"When hazards within the provisions of the Act are found, notice will be given to the responsible parties that they must be removed. If after notice duly given they are not removed, it is my purpose to declare them public nuisances and to recommend that action be taken under Section 1004 of the Act."

SAFETY-STRIPS: Along railroads, safety-strips from 100 to 200 feet from the rails may be lightly burned. At the outer edge of this strip a trail of bare soil may be dug or plowed. Several fresh furrows should parallel the railroad in the spring and fall along grass and waste fields. Owners of land along railroads should be urged to take some precautions against fire, and not depend entirely upon the railroad company.

Burning should be started at the bare soil strip and proceed toward the track. Extreme care is necessary to prevent the fire getting beyond control and doing damage instead of good.

All slash, brush, and rubbish that will burn, or in which fires may start, within 150 feet of a railroad track ought to be disposed of by burning or be otherwise removed. Similarly such material should be removed from a twenty-five foot strip along traveled highways and electric railways. If such material is not allowed to accumulate careless travelers will not cause so many fires.

Around sawmill and other engines which are operated in or near forests all inflammable refuse should be removed within a circle having a radius of at least 150 feet, with the engine as the centre.

In the woods, when the trees are cut, everything in the tree that can be used should be taken out, leaving only the small branches.

These may be burned in piles or scattered over the ground where they will soon decay. All dead trees, standing or down, should be used if possible. Decaying trees, crooked trees, and trees which are of little present or future value should be cut before the sound and valuable trees are cut. Keeping the forest free from such rubbish helps to prevent the start and the spread of forest fires.

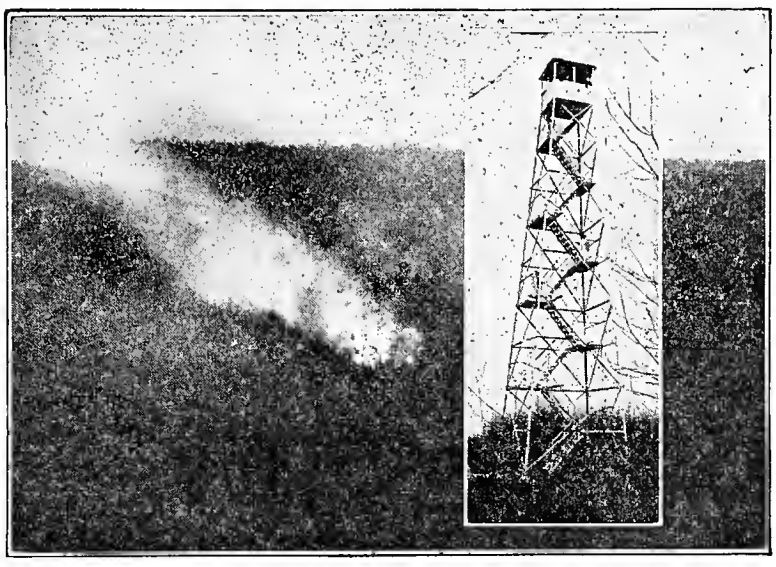
By keeping roads and trails through woodlands open and at least a foot of their surface bare to the mineral soil, fires may be attacked promptly and kept within a small area.

FIRE EXTINCTION: Next to preventing fires, it is important to extinguish at once all fires that may start.

The fire, when discovered, should be reported immediately, and should be attacked promptly by persons who know how to fight it. The fire fighters should be organized, but one person can do much by hitting the line of fire wherever possible and sticking to it.

PRESENT FOREST FIRE ORGANIZATION.

WARDENS: The State of Pennsylvania has an organization of forest fire wardens who prevent and extinguish forest fires. The State's Chief Forest Fire Warden is in the Department of Forestry at Harrisburg. He directs the fire prevention work of the Foresters in charge of the twenty-four districts into which the State is divided. The District Foresters supervise the activities of more than 2,800 local and special forest fire wardens.



TOWERS: There are 111 observation stations in the forested areas of the State. During fire seasons watchmen, or lookouts, are on these towers. Towers are connected with telephone lines, so

that fire fighting crews may be summoned promptly. There are also a number of men appointed to do patrol duty in dangerous seasons. The special duty of towermen and patrolmen is to discover and report the locations of fires.

This organization is constantly on the alert to detect, to report and put out forest fires. The effectiveness of the organization depends upon the cooperation of the citizens with the wardens. These citizens report forest fires to the nearest wardens who will go promptly to extinguish them. This may be done by telephone, telegraph, messenger, bell, whistle, or by other methods.

In addition to the Foresters, Forest Rangers, and Forest Fire Wardens of the Department of Forestry there are other persons who are cooperating in forest fire prevention:

State Game Wardens are also forest fire wardens.

State Policemen are forest fire wardens.

State Highway employes furnish men, tools, and trucks, for fire extinction.

Rural mail carriers are designated forest fire patrolmen by the United States Postmaster General, with instructions to report fires promptly to the nearest local forest fire warden.

Telephone companies in Pennsylvania instruct their operators to refer forest fire calls directly to a forest fire warden.

Railroad companies have had section foremen who are located near woodlands made special forest fire wardens.

Individuals and corporations have had regular employes appointed special wardens.

Individuals and organizations, particularly the Forest Protective Associations, Boy Scouts, Fish and Game Associations, Chambers of Commerce, etc., cooperate with the Department of Forestry.

FIRE CREW: Usually wardens need help to put out forest fires. It is important that those who help know where to go and what to do. A few people well-organized into a crew and working in cooperation are of much more value at a fire than a large number disorganized and without method in their work.

A good crew is made up of a foreman, who should be a forest fire warden, or some one designated by him. There should be one or two axemen according to location of the fire to remove brush or logs from line of attack; three or four men with rakes to clean a trail, exposing mineral soil, from which to start a back-fire, or up to which the fire may burn and stop; a torchman to start a back-fire; three or four guards to watch the back-fire

and see that it does not throw sparks across the trail, and one man or boy to carry water.

The crew members should respond promptly and assemble at a prearranged place. Each man should have the same work to do every time he goes on the fire-line.

FIGHTING FOREST FIRES.

PROMPT ACTION: The efficiency of a warden and his local organization is determined by the time which elapses between the start of the fire and the first attack. There should be no excuse for delay after a fire is known to exist. Quick action reduces expense, loss, hard work, and prevents big fires. Small fires are easily subdued. It is true that fire fighting is more effective in the evening, night, or early morning, but it is a criminal waste to wait until that time to begin.

TRANSPORTATION PREARRANGED: The warden should have arrangements made in advance of the fire season for transportation of fire fighters. It is not difficult to arrange with automobile owners and drivers to furnish cars on short notice for this kind of service. But the plans must not be delayed until a fire starts.

CALL OF CREW: If a fire-fighting crew is well organized its members can be brought together in a short time when a prearranged signal is sounded. This signal may be a local alarm, bell or whistle. It should be understood where the crew is to meet. Additional help, if needed, should be summoned by telephone. In some towns, arrangements have been made to sound forest fire alarms on the usual municipal fire bell or whistle. A distinctive forest fire alarm has been agreed upon so there will be no confusion.

Ordinarily, it is not wise to call out more than two or three crews at the first call, unless the fire already has a good start, or that it is likely to become dangerous in a very short time. On the other hand, it is always well to remember that it is better to have one or two crews too many than to be one crew short. If, after reaching the fire it is found that more men will be needed, no time should be lost in sending for additional forces. If necessary, nearby fire wardens should be notified by telephone or telegraph.

ORGANIZED WORK: At a fire, the forest fire warden is in charge. He must keep the crew under his control at all times. Those who go to a fire should report to a warden. If the warden is absent, a foreman should be selected. The proper control of a crew requires skill and judgment. Too many bosses in a fire-fighting

crew slow up the attack. Determine upon a method of attack, and follow it fast and hard. If more than eight or ten men are present, the force may be divided, with a foreman in charge of each crew. Each crew should be stationed at some important place on the fire line. In this way the fire may be more effectively controlled. By putting each man to the work he can do best, the whole force will be used to best advantage. For example, at a light surface fire one crew may be sent along the fire line with extinguishers or sprayers followed by men with rakes, shovels, hoes or brooms to clear the ground of litter and prevent the fire from crossing the line. Another crew may be sent for water to keep the spray tank supplied. Or in case of a fire sweeping through brush and timber, if back-firing is resorted to, the foreman should go ahead and decide on the line from which the back-firing is to be done; one or two axemen should follow, then several men with forked sticks, rakes, brooms, hoes, shovels, mattocks, etc., should clear the trail down to bare earth. One torchman, to set the back-fire, is usually sufficient. He should be followed by guards, who are sometimes equipped with sprayers or chemical extinguishers, to prevent fire crossing the trail. The rear guard must be the most reliable man of the crew for he must see that the fire line is safe before he moves up the line.

CARE OF CREW: Forest fire fighters need water, food, and rest. Everyone going to fight a forest fire should take a lunch along. The other actual needs of the men should be supplied as far as possible. If any men are allowed to go home for food or supplies they may not return promptly. The crew should work in shifts if necessary.

LOCATION OF FIRE. It is important to know where the fire is before starting out. Some one, usually the warden, should telephone promptly to persons who can see the fire or smoke from it. The location of the fire can best be obtained from the watchman on the nearest fire observation tower. False alarms are sometimes sounded, but it is better to respond to a false alarm than to let a fire get well started.

ATTACK: Upon arrival at the fire, the person in charge should find out two things as soon as possible: (1) which part of the fire is advancing most rapidly; (2) the location of forest growth or other valuable property which is likely to be destroyed. No two fires are alike, even though they may occur under similar conditions, and in deciding the method of attack the warden, or crew leader, is required to apply his knowledge of conditions and his skill in handling his men. The two things for which he must work, therefore, are

limitation of the area burned-over, and control of the damage to timber. He must decide quickly whether to place his men between the fire and the valuable forest growth or in front of the rapidly-spreading flames. In the majority of cases the latter is the logical course. The warden should judge the speed of the fire and decide how far ahead of it he will start his attack. He should know the distance to the nearest fire-break, such as a trail, road, brook, field, etc.

It is assumed the warden will be prompt, and that he and his crew will arrive while the fire is small. But if for any reason a warden must attack a large fire he should take the men to the front, start the attack at a favorable place, and then size up conditions, going entirely around the fire if necessary. No time must be lost, but a half-hour spent in making good plans after a complete investigation, may determine the success or failure of the fight.

"For instance, to beat out a hot fire line in the woods within a short distance of a road in a dry time is generally mistaken judgment, since the fire is exceedingly likely to break over again as it would not with the bare soil of the road to help control it; or spreading a limited force of fighters on a long fire line, part of which is headed toward a natural barrier, and part of which is not, weakens the work where most needed and spends effort where unnecessary.

"Fire can be headed or directed into natural barriers like swamps, clearings, old burns, hedges, etc., by choosing which portion of the head fire to attack first, when the whole fire line cannot be met promptly and effectively because of its magnitude or of lack of help. Judgment used in this way is worth more than hours of labor."—New Jersey Circular.

METHODS OF FIGHTING.

There are many methods of fighting forest fires. Some are good and some are not. Some men think their method is the only correct one. A good warden is always ready for useful suggestions, and is willing to give them fair trial. Methods of fighting vary with the character of the fire, type of the forest, condition of the atmosphere, strength and direction of the wind, rapidity of the fire's advance, topography, and material on the ground.

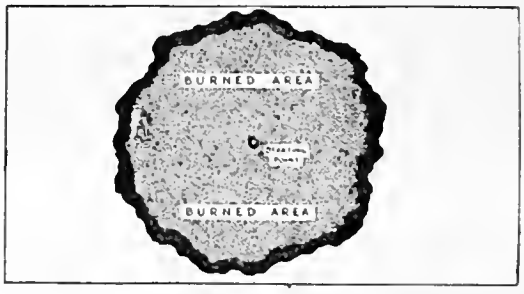
TREE FIRES: These are stopped by shutting off the air which makes a draft through the hollow trunk. Close the hole at the ground if possible with dirt. If this cannot be done, the ground around the burning tree should be cleared, and the tree should be felled. The fire can then be smothered inside and outside. If water is available, the fire may be put out with force pump or sprayer or chemical extinguisher without felling the tree. Dead snags in forests

should be felled as a matter of fire prevention as well as for the benefit of the forest.

SOIL FIRES: These fires can be stopped only by digging deep enough to prevent their spread. The ditch, as well as the surface should be flooded if possible. This, however, is seldom possible. Where a soil fire has a good start it may be cheaper to blast a ditch than to dig one. Well-placed dynamite will do effective work in a short time.

CROWN FIRES: We have few crown fires in Pennsylvania. Natural conditions as to topography and growth are the best means of stopping any that may occur.

SURFACE FIRES: This is the kind of fires which occur most frequently in Pennsylvania. If there is little wind the flames may be put out by beating with branches (pine preferred), shovels, and wet burlap. Fire fighters should beat the flames with a side sweep toward the fire to avoid spreading sparks. Sweeping with old



How a Forest Fire Burns When There is no Wind.*

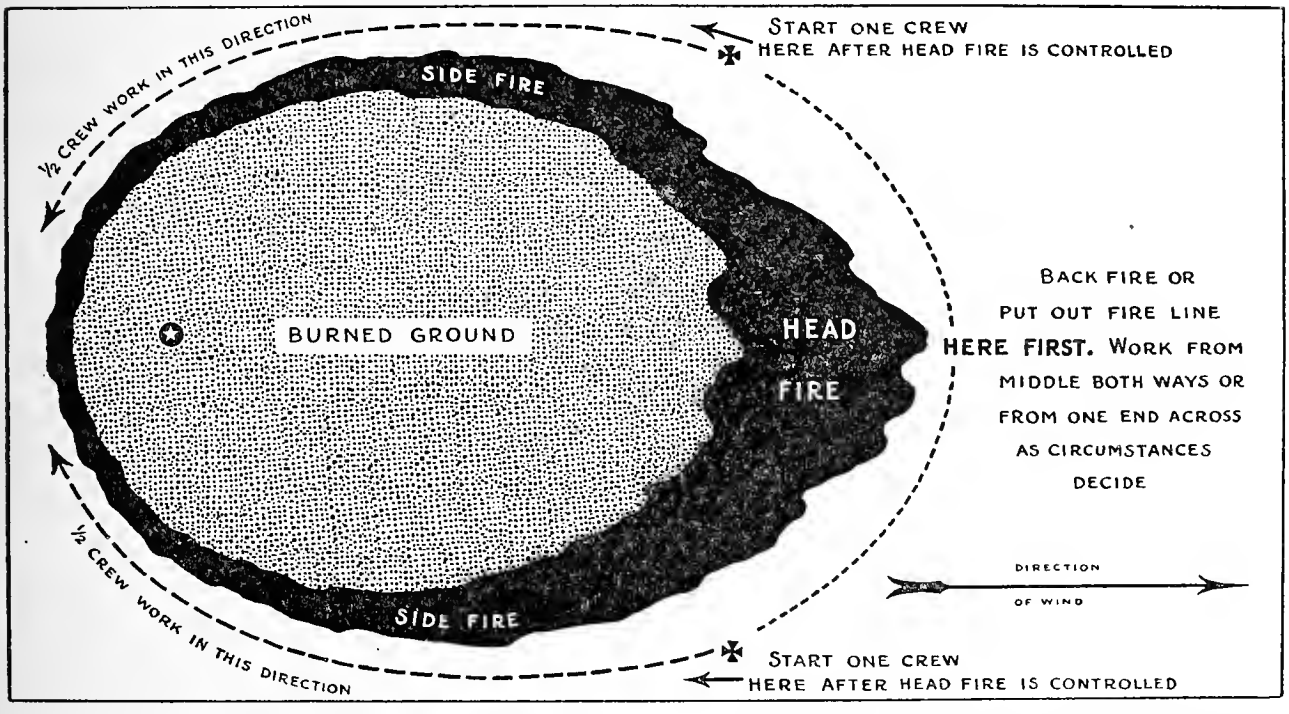
brooms, brooms made of branches, or steel brooms, is better than beating. The burning material may be pushed back upon the burned-over ground with rakes, sticks, forks, or other tools. The idea is to separate the burning material from that not yet afire. Water is always effective, but too frequently dependence is placed on it, and when it is not available fire fighters seem to be at a loss to know how to make their attack. The fire can be smothered by throwing on dry or moist sand or dirt. If it is possible to plow, a furrow may be thrown up quickly to restrict the spread of the fire.

Sometimes small or lightly-burning fires are beaten out. If no trail is cleared to the bare ground entirely around the burned area, here and there small pieces of smouldering wood may be fanned into flame and the fire may again break out. **It is always a safe practice to make a clean trail with exposed mineral earth entirely around the burned area.**

*This cut and those on pages 11, 13, 17, and small one on 16 from New Jersey circular.

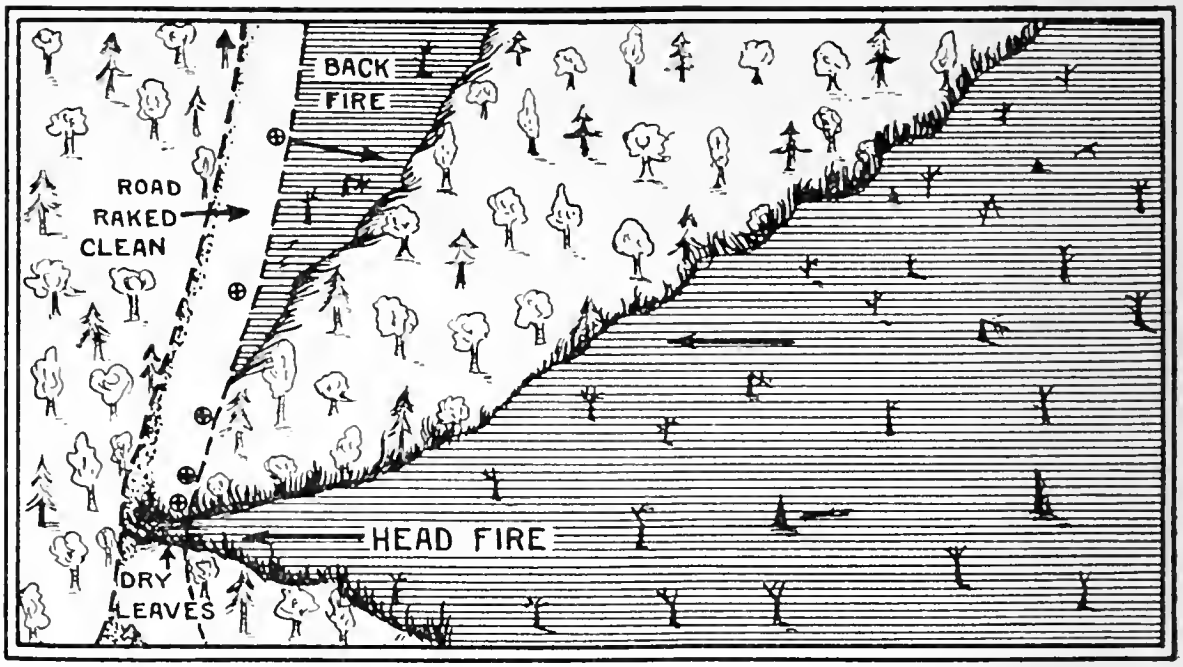
Chemical extinguishers are sometimes used. Careful tests have been made by foresters and it has been found that the chemical spray is of no more value in the woods than is plain water with a little force back of it. This force can be supplied by a foot pump, or by air pressure, as in the ordinary fruit spraying devices. Sprinkling water in front of the fire reduces the force of the flames and permits close beating and raking. To be effective, considerable water is required when it is sprinkled directly on the flames. Water is used to the best advantage when the stream is thrown at the ground immediately in front of the flames. The water and force combined will stop the flames' advance. It is also satisfactory to spray water against the base of the flames from the rear particularly if there is much smoke.

BACK-FIRING: When the wind is strong or when the flames are in slash, fallen logs, dead ferns, bracken, or grass, fire becomes so intense that it is unsafe and impracticable to attempt close attack. Back-firing is resorted to in such cases. It should be remembered that fire is a dangerous force and that when fire is fought with fire extreme care and keen judgment must be used. If a fire starts some area will be burned-over and some growth will be damaged, but in order to reduce the damage as much as possible some additional sacrifice may have to be made by starting a back-fire. The area to be covered by the back-fire should, however, be kept as small as is practicable.



The Correct Way to Attack Any Forest Fire. Always Work From in Front Toward the Rear. Stop the Head Fire First and Work Far Enough to Each Side So That the Side-fire Cannot Work Around to Make a New Head-fire.

Frequently under excitement, the speed at which the original fire is traveling is misjudged and a back-fire is started too close to it or too far in advance of it, usually the latter. Occasionally a back-fire has been set at the foot of a mountain along a road to stop a fire just coming over the top. Sometimes a land owner has set a back-fire along his property line without regard to where it may go or where the original fire was. Indiscriminate back-firing cannot be



The Incorrect Way to Attack by Back-fire. The Head-fire Reaches the Fire-break and Jumps Over it Before the Back-fire Reaches the Point of Advantage.

condemned too strongly. A lack of information regarding the locations of fire breaks already established and the topography may result in errors in back-firing. (Everyone should be on the watch for such cases and report them.) Such errors should be reported to the person in charge of the fire-fighting crews. After the necessity for starting a back-fire has been determined—and not before—the back-fire should be started as close to the main fire as practicable. Sometimes back-fires do not stop the original blaze. In that case the crew must drop back to a second line of defense and renew the attack. The retreat should be made promptly and the new fight started at once from the most advantageous position.

Fire burns slowly down hill, and rapidly up hill. Therefore, a good place to start a back-fire is just over the brow of a hill up which a fire is advancing on the opposite side. Fires burn slowly against the wind and rapidly with the wind. The heat and draft from the advancing fire attracts the heat from the back-fire and hastens the advance of the latter when the two are approaching. Observation of the force and direction of the wind will give warning in time

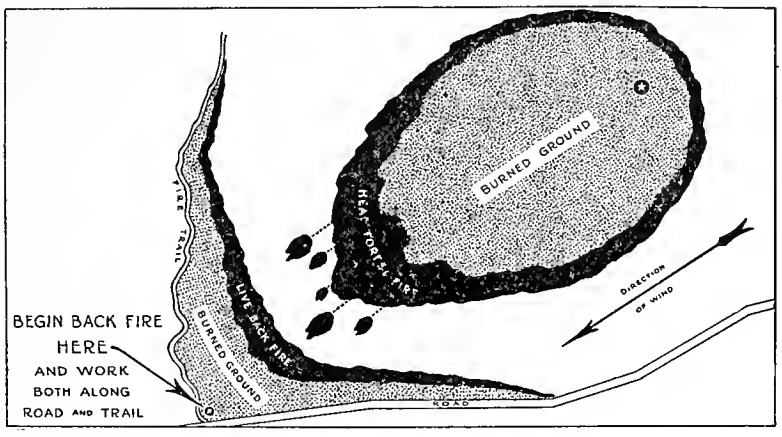
to protect the men. It will also indicate whether a quick advance should be made to another point that is threatened by the flames.

A back-fire should be started from a fire-break, such as a road, stream, or other natural barrier. In case a fire-break is not found at

A Back-fire should be Started at a Road, an Open Trail or a Stream.

the proper place for back-firing, one must be made. The ground should be cleared so that the damp mineral soil is exposed. Such a trail can be made very quickly even through brush with forked sticks, if no other tools are available. Of course, axes, brush hooks, rakes, hoes, shovels, and brooms are better tools.

Usually the smoke is thickest, fighting is most uncomfortable, and danger of spark-spreading is greatest in line with the draft of the fire. The back-fire should be started at this point, and every man available is needed there. The back-fire should be started at the



Where an Angle Can be Used, the Back-fire May Have to be Longer, But the Area Burned by the Back-fire is Reduced. Be Careful that the Side-fire Does Not Come Up Before the Wings of the Back-fire are Safe.

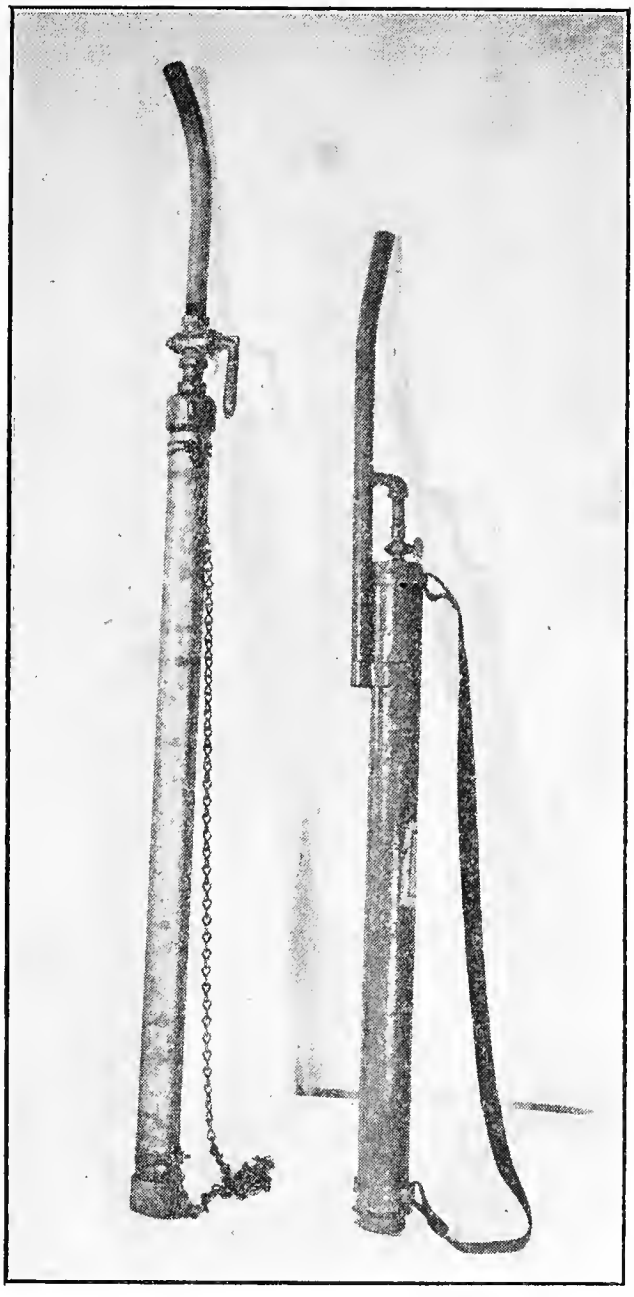
lower point of a V, the sides of which are open enough and extended far enough to include the header of the advancing fire. The whole crew is available to attack promptly the spot fires in case sparks cross the fire-break. As soon as the header is halted the side lines of the back-fire may be drawn in close to the side lines of the main

fire and continued parallel to them, or even run into them. The rest of the fire-line may be beaten out. Remember, however, that a trail cleared to mineral soil should extend entirely around each fire to make it safe. The crew, even if small, should be divided at the point of the V, with a few more men on the side which should be advanced more rapidly or on which the danger is greater because of the wind.

A satisfactory arrangement of crews is as follows: the warden or foreman directs the course and location of the fire-break, if one must be made. He is in charge of the whole fire-fighting force and should urge each man to do his best. According to the amount of brush to be cut one or two axemen or brushcutters follow the warden. Four men with small wooden rakes, or some other tool, one

A Wooden Rake Makes a Clean Trail.

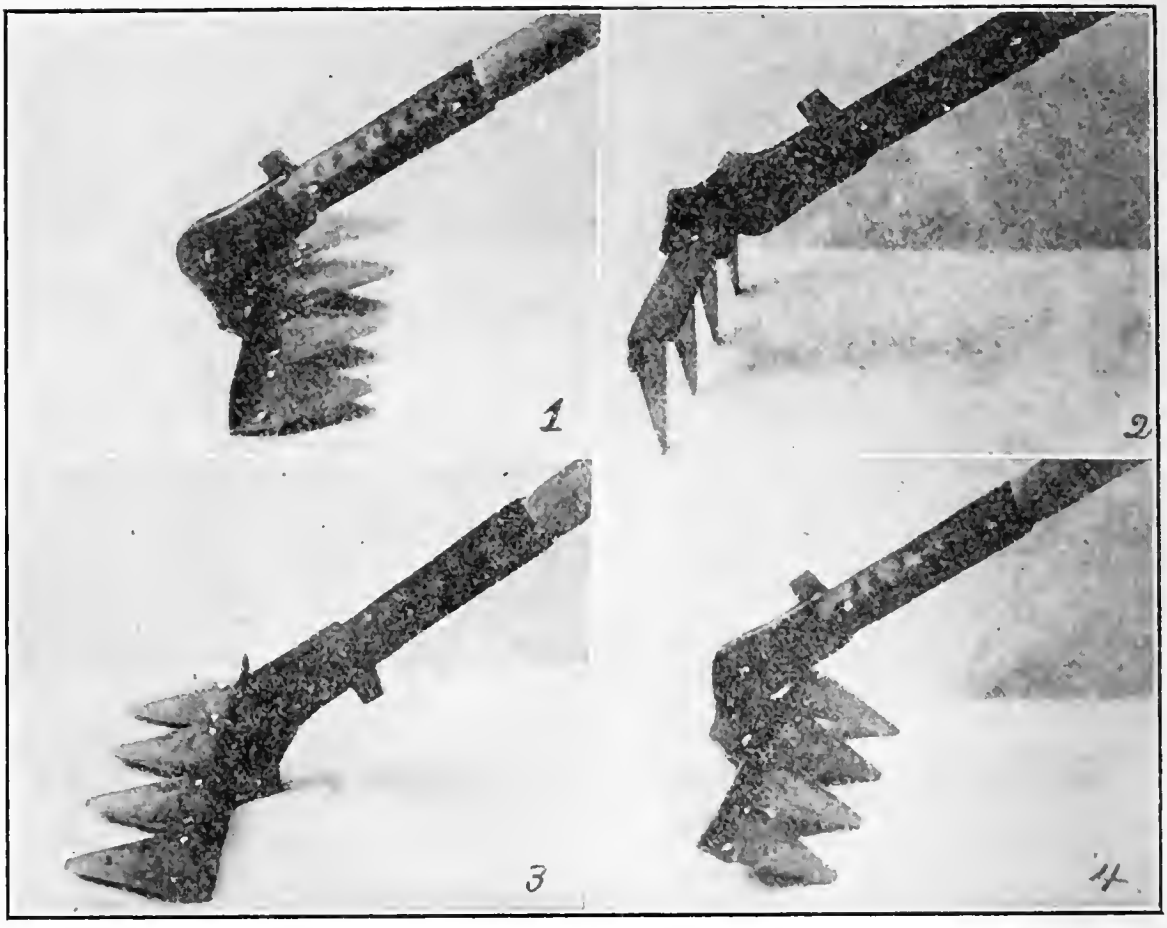
working close to the other, make a clean trail, exposing the mineral soil, raking the material to the side away from the fire unless it is needed to start a back-fire. Next comes a man with a torch. He must not set fire too rapidly for the nearest raker, nor for the guards who follow him. If the torchman sets fire too rapidly for the rakers the heat may drive them off their course, and if too rapidly for the guards, the fire may not burn away from the trail fast enough to permit their moving up with the torchman. As a result sparks may blow across the trail where there will be no one to discover and stamp them out immediately. Four alert and active guards can take care of a long line of back-fire. They should have three-gallon spray tanks and a continuous supply of water. They should have also a rake or broom. Pine brush may be used in the absence of a better tool. The rear guard must be the most dependable man in the crew for he must determine when the line is safe and must not leave it until it is safe. It is important that someone who knows the woods after dark should be detailed to carry water.



Back-fires Are Started With Torches—

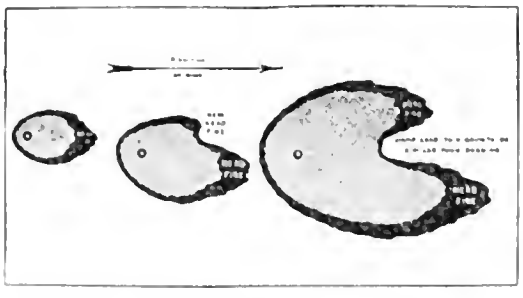
Some authorities do not recommend a back-fire except as a last resort. There is no reason, however, why the principles of back-firing may not be used at every fire, no matter how small. Some persons recommend that a fire should be attacked where it is first met. This point, however, may be where it is doing the least damage. The essential point in forest protection is not merely to put a fire out, but to put it out in the shortest possible time, to restrict it to minimum area and damage. Therefore, it should be attacked where it is making most headway or where it is doing most damage. Some recommend attacking a fire on the side-line near the front. They contend the front is gradually narrowed and weakened until it is

easily subdued by reducing the amount of fire and draft. There is some merit to this method, but it is a makeshift.



The Rich Fire-tool, Which Can Be Adjusted Into Four Positions, is the Most Effective Fire-fighting Instrument.

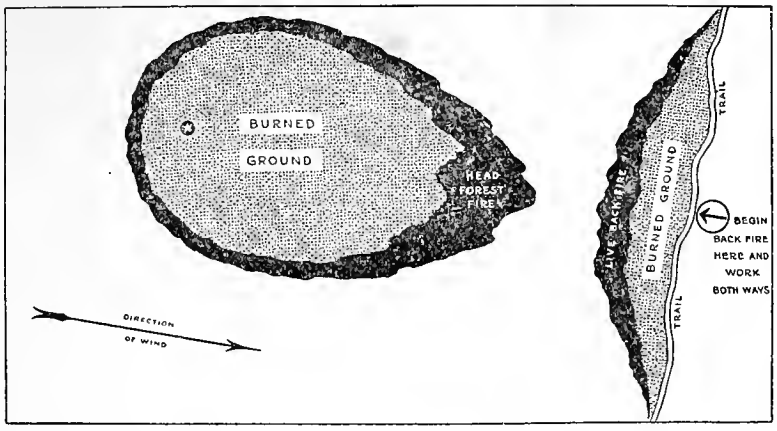
When fire runs into rocks, or burns over a very rocky area, it may be necessary to do considerable quarrying to establish a safety trail around the burned area. In such cases it may be necessary to start a back-fire at the outer edge of the rocks and let the fire smoulder under them. This should be done only after careful consideration of expense and damage.



How a Side-Fire May Develop a New Head-fire.

In rough hilly country several headers may develop because of topography. The size of the force available will determine how

these headers should be handled. After one header has been subdued a change of wind may cause this situation to arise. It is always poor policy, therefore, to delay the attack on both side lines. As long as a flame burns prompt and continuous action is required.



If Worked Straight Across the Head-fire, the Back-fire Must Be Long Enough to Check Not Only the Narrow Head-fire, But Also the Full Width of the Fire Behind.

The foregoing illustration is described by a forester as follows: "It is useless to try to head off a fire ascending a steep slope. My method has been to start a back-fire at the top of the slope, dividing my men into two crews, each running a line away from the other, at right angles to the direction of the oncoming fire until it is safe to run the line down the slope in the direction of the fire, flanking it and finally catching it in the rear." This is a satisfactory method of attack.

Occasionally a back-fire is started at the bottom and diagonally to the slope of a hill. As a result, usually the uphill draft causes the fire to move more rapidly than the men can handle it, and it sometimes gets away. If this method is necessary, the back fire should be started at the top and worked down, running directly with the wind or at an angle to it. It pays to take the time to walk up a hill before starting the back-fire.

It is advisable to do some thinking after a fire has been extinguished. Review the plan of attack and consider whether better plans might have been made so that the fire could have been more quickly and more easily extinguished.

THE LAST SPARK: No fire is out until the last spark is dead. Sometimes wardens and men leave as soon as the flames have been extinguished, with the result that frequently the fire has started up again at one or more places. Then the fire has to be fought again; it is larger, is harder to subdue, takes more time, costs more, burns

over more area, and does more damage than the first fire. No chances should be taken with its breaking out a second time. All but the most dependable men should be discharged. The burned area should be inspected to see that there is no danger of fire creeping across the trail which ought to have been cleared around the burned area. Threatening brands should be thrown far into the burned area; logs and branches holding fire should be rolled over and sprinkled with water or covered with dirt until they are safe. Punky stumps should be examined and broken apart to see that they can give off no sparks. Burning snags standing within several hundred feet of the unburned area should be cut down. Every precaution should be taken to prevent a recurrence of the fire. If a fire has been put out during the day, the tract should be patrolled until the wind goes down in the evening, or until dew falls. If the fire has been extinguished in the morning and there is the least danger of its starting again, the area should be patrolled until the next afternoon or evening.

No fire is out until the last spark is dead.

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